

SIMATIC S5

Programming Guide

**S5 Standard Function Blocks
for S7-300 Analog Modules in ET 200M**

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1 Summary

This programming guide describes the use of the standard function blocks FB34 - FB37. They enable S7 analog modules in an ET200M to be controlled from an S5 programmable controller. The prerequisite for the use of the standard FBs is that the ET 200M parameter "Analog-value format" must be set to "S5 format".

The interface between the S5 CPU and ET200M is implemented via PROFIBUS-DP by means of the following interface modules: IM308-C in the S5 programmable controller and IM153-1 in the ET200M distributed I/O station of the S7.

It is assumed you have read the operating instructions for S7 analog modules and the relevant programmable controller.

Block Number	Block Name	Purpose
FB 34	AN_EIN_F	Reads analog value (fixed point)
FB 35	AN_AUS_F	Outputs analog value (fixed point)
FB 36	AN_EIN_G	Reads analog value (floating point)
FB 37	AN_AUS_G	Outputs analog value (floating point)

The standard blocks can be run with the following S7 analog modules:

Input modules: SM 331; AI 8 x 12 bits
 SM 331; AI 2 x 12 bits
 SM 334; AI 4/AO 2 x 8/8 bits

Output modules: SM 332; AO 4 x 12 bits
 SM 332; AO 2 x 12 bits
 SM 334; AI 4/AO 2 x 8/8 bits

Approved CPUs:

File	PLC	Approved CPU	FB34	FB35
ANA_S7ST.S5D	115U	941-944	X	X

File	PLC	Approved CPU	FB34	FB35	FB36	FB37
ANAGS7ST.S5D	115U	945	X	X	X	X
	135U	922	X	X	X	X
		928 / 928 B	X	X	X	X
	155U	946/947	X	X	X	X
		948	X	X	X	X

2 Description of the Blocks

2.1 FB 34: AN_EIN_F

FB 34 reads an analog value from an S7 analog input module (via IM 308C/IM 153) and supplies a standardized value as a 16-bit fixed-point number at the XA output. The value range of the XA output value is defined by means of the OGR and UGR parameters. In the standardization process, the function block takes into account the different rated ranges by means of the KNKD (channel number and representation) parameter.

2.1.1 Calling FB 34

<pre> FB 34 +-----+ ! AN_EIN_F ! --!BG XA!-- --!KNKD FB!-- --!OGR BU!-- --!UGR !-- +-----+ </pre>	<pre> :SPA FB 34 Name :AN-EIN-F BG : KNKD : OGR : UGR : XA : FB : BU : </pre>
--	---

2.1.2 Description of the Parameters

Name	Mode	Type	Description	Assignment, Comments
BG	D	KY	I/O area and module address	KY = x,y x = 0 for P area x = 1 for Q area y = 0 to 254
KNKD	D	KY	Channel number and representation	KY = x,y x = 0 to 7 for the channel number y = 26 to 33 for the channel representation (see below)
OGR	D	KF	Upper limit	16-bit fixed-point number
UGR	D	KF	Lower limit	16-bit fixed-point number
XA	A	W	Output value	Converted value between OGR and UGR (as 16-bit fixed-point number)
FB	A	BI	Error bit	See below
BU	A	BI	Overrange	See below

BG

When the block is used in the 941-944 CPUs, only the P I/O area is released.

KNKD Channel number and representation

The channel number specifies which channel on the analog module is to be addressed.

The rated range of the analog value that is read varies depending on the measurement range. To enable the function block to carry out standardization in the OGR and UGR limits correctly, the KNKD parameter must be supplied as follows:

KD = 26	Rated range -27648 to +27648	
KD = 27	Rated range 0 to +27648	
KD = 28	Rated range -2000 to +8500	(PT100)
KD = 29	Rated range -600 to +2500	(Ni100)
KD = 30	Rated range -2700 to 13720	(temperature range type K)
KD = 31	Rated range -2700 to 13000	(temperature range type N)
KD = 32	Rated range -2100 to 12000	(temperature range type J)
KD = 33	Rated range -2700 to 10000	(temperature range type E)

FB Error bit

Has the signal state "1" if bit 2¹ of the analog value read has the signal state "1" (wire break).

BU Overrange

Has the signal state "1" if bit 2⁰ of the analog value read has the signal state "1" (overflow) or if the analog value read does not lie within the rated range limits.

2.1.3 Error Handling

In normal processing, the RLO = "0" when the function block is exited, and accumulator 1 contains the value read by the module (non-linearized value).

FB 34 sets the FB parameter to "1" when bit 2¹ of the analog value read has the signal state "1" (wire break). When the error bit is set, FB 34 sets the RLO to "1" and writes zero to the XA output value. Accumulator 1 contains the non-linearized value read by the module.

FB 34 sets the BU parameter to "1" when bit 2⁰ of the analog value read has the signal state "1" (overflow) or when the analog value read does not lie in the rated range. If overrange is set, FB 34 sets the RLO to "1" and writes the relevant rated range limit value (standardized) to the XA output value. Accumulator 1 contains the non-linearized value read by the module.

In the event of a parameterization error, the function block sets the RLO to "1". The output value is zero, and FB and BU have the signal state "0". An error number is passed in accumulator 1:

- 1 I/O area invalid (BG left byte)
- 2 Channel number invalid (KNKD left byte)
- 3 Channel address exceeds the value 254
- 4 Channel representation invalid (KNKD right byte)
- 5 OGR <= UGR

If a non-existent module or channel is selected, there is a timeout. If the CPU then branches to the STOP state, you find the value "00FFh" in accumulator 2 by means of the interrupt stack.

Note: For standardization, the function block FB34 (AN_EIN_F) from the ANA_S7ST.S5D file requires the standard function blocks FB1 to FB4 from the "Basic functions" package.

2.2 FB 35: AN_AUS_F

FB 35 converts an XE input value (16-bit fixed-point number) into a format that is comprehensible for S7 analog modules in accordance with the rated range between OGR and UGR and outputs it to an analog output module (via IM 308C/IM 153).

2.2.1 Calling FB 35

FB 35 +-----+ ! AN_AUS_F ! --!XE BU!-- --!BG !-- --!KNKT !-- --!OGR !-- --!UGR !-- +-----+	:SPA FB 35 Name :AN-AUS-F XE : BG : KNKT : OGR : UGR : BU :
--	--

2.2.2 Description of the Parameters

Name	Mode	Type	Description	Assignment, Comments
XE	E	W	Input value	16-bit fixed-point number between UGR and OGR
BG	D	KY	I/O area and module address	KY = x,y x = 0 for P area x = 1 for Q area y = 0 to 254
KNKT	D	KY	Channel number and type	KY = x,y x = 0 to 3 for the channel number y = 0 to 1 for the channel type (see below)
OGR	D	KF	Upper limit	16-bit fixed-point number
UGR	D	KF	Lower limit	16-bit fixed-point number
BU	A	BI	Overrange	BU = 0: UGR ≤ XE ≤ OGR BU = 1: XE < UGR or XE > OGR

BG

When the block is used in the 941-944 CPUs, only the P I/O area is released.

KNKT Channel type

The channel number specifies which channel on the analog module is to be addressed.

The rated range of the analog value to be written varies depending on the measurement range. To enable the function block to carry out standardization in the OGR and UGR limits correctly, the KNKT parameter must be supplied as follows:

KT = 0 Rated range 0 to +27648 (unipolar)

KT = 1 Rated range -27648 to +27648 (bipolar)

2.2.3 Error Handling

In normal processing, the RLO = "0" when the function block is exited, and accumulator 1 contains the value written to the module (xa).

FB 34 sets the BU parameter to "1" when the specified XE input value is outside the range defined by the UGR and OGR parameters. When overrange is set, FB 34 sets the RLO to "1" and outputs the relevant limit value to the module. Accumulator 1 contains the non-linearized value written to the module.

In the event of a parameterization error, the function block sets the RLO to "1". A value is not written to the analog output module, and BU has the signal state "0". An error number is passed in accumulator 1:

- 1 I/O area invalid (BG left byte)
- 2 Channel number invalid (KNKT left byte)
- 3 Channel address exceeds the value 254
- 4 Channel type invalid (KNKT right byte)
- 5 OGR <= UGR

If a non-existent module or channel is selected, there is a timeout. If the CPU then branches to the STOP state, you find the value "00FFh" in accumulator 2 by means of the interrupt stack.

Note: For standardization, the function block FB35 (AN_AUS_F) from the ANA_S7ST.S5D file requires the standard function blocks FB1 to FB4 from the "Basic functions" package.

2.3 FB 36: AN_EIN_G

FB 36 reads an analog value from an S7 analog input module (via IM 308C/IM 153) and supplies a standardized value as a floating-point number at the XA output. The value range of the XA output value is defined by the user by means of the OGR and UGR parameters. In the standardization process, the function block takes into account the different rated ranges by means of the KNKD (channel representation) parameter.

2.3.1 Calling FB 36

FB 36 +-----+ ! AN_EIN_G ! --!BG XA !-- --!KNKD FB !-- --!OGR BU !-- --!UGR !-- +-----+	:SPA FB 36 Name :AN-EIN-G BG : KNKD : OGR : UGR : XA : FB : BU :
--	---

2.3.2 Description of the Parameters

Name	Mode	Type	Description	Assignment, Comments
BG	D	KY	I/O area and module address	KY = x,y x = 0 for P area x = 1 for Q area y = 0 to 254
KNKD	D	KY	Channel number and representation	KY = x,y x = 0 to n for the channel number y = 26 to 33 for the channel representation (see below)
OGR	D	KG	Upper limit	Floating-point number
UGR	D	KG	Lower limit	Floating-point number
XA	A	D	Output value	Converted value between OGR and UGR (as floating-point number)
FB	A	BI	Error bit	See below
BU	A	BI	Overrange	See below

KNKD Channel number and representation

The channel number specifies which channel on the analog module is to be addressed.

The rated range of the analog value that is read varies depending on the measurement range. To enable the function block to carry out standardization in the OGR and UGR limits correctly, the **KNKD** parameter must be supplied as follows:

KD = 26	Rated range -27648 to +27648	
KD = 27	Rated range 0 to +27648	
KD = 28	Rated range -2000 to +8500	(PT100)
KD = 29	Rated range -600 to +2500	(Ni100)
KD = 30	Rated range -2700 to 13720	(temperature range type K)
KD = 31	Rated range -2700 to 13000	(temperature range type N)
KD = 32	Rated range -2100 to 12000	(temperature range type J)
KD = 33	Rated range -2700 to 10000	(temperature range type E)

FB Error bit

Has the signal state "1" if bit 2¹ of the analog value read has the signal state "1" (wire break).

BU Overrange

Has the signal state "1" if bit 2⁰ of the analog value read has the signal state "1" (overflow) or if the analog value read does not lie within the rated range limits.

2.3.3 Error Handling

In normal processing, the RLO = "0" when the function block is exited, and accumulator 1 contains the value read by the module (non-linearized value).

FB 34 sets the FB parameter to "1" when bit 2¹ of the analog value read has the signal state "1" (wire break). When the error bit is set, FB 34 sets the RLO to "1" and writes zero to the XA output value.

Accumulator 1 contains the non-linearized value read by the module.

FB 34 sets the BU parameter to "1" when bit 2⁰ of the analog value read has the signal state "1" (overflow) or when the analog value read does not lie in the rated range. If overrange is set, FB 34 sets the RLO to "1" and writes the relevant rated range limit value (standardized) to the XA output value. Accumulator 1 contains the non-linearized value read by the module.

In the event of a parameterization error, the function block sets the RLO to "1". The output value is zero, and FB and BU have the signal state "0". An error number is passed in accumulator 1:

- 1 I/O area invalid (BG left byte)
- 2 Channel number invalid (KNKD left byte)
- 3 Channel address exceeds the value 254
- 4 Channel representation invalid (KNKD right byte)
- 5 OGR <= UGR

If a non-existent module or channel is selected, there is a timeout. If the CPU then branches to the STOP state, you find the value "00FFh" in accumulator 2 by means of the interrupt stack.

2.4 FB 37: AN_AUS_G

FB 37 converts an XE input value (floating-point number) into a format that is comprehensible for S7 analog modules in accordance with the rated range between OGR and UGR and outputs it to an analog output module (via IM 308C/IM 153).

2.4.1 Calling FB 37

```

      FB 37
+-----+
!  AN_AUS_G  !
--!XE      BU!--
--!BG      !--
--!KNKT     !--
--!OGR      !--
--!UGR      !--
+-----+

:SPA FB 37
Name :AN-AUS-G
XE  :
BG  :
KNKT:
OGR :
UGR :
BU  :

```

2.4.2 Description of the Parameters

Name	Mode	Type	Description	Assignment, Comments
XE	E	D	Input value	Floating-point number between UGR and OGR
BG	D	KY	I/O area and module address	KY = x,y x = 0 for P area x = 1 for Q area y = 0 to 254
KNKT	D	KY	Channel number and type	KY = x,y x = 0 to 3 for the channel number y = 0 to 1 for the channel type (see below)
OGR	D	KG	Upper limit	Floating-point number
UGR	D	KG	Lower limit	Floating-point number
BU	A	BI	Overrange	BU = 0: UGR ≤ XE ≤ OGR BU = 1: XE < UGR or XE > OGR

KNKT Channel type

The channel number specifies which channel on the analog module is to be addressed.

The rated range of the analog value to be written varies depending on the measurement range. To enable the function block to carry out standardization in the OGR and UGR limits correctly, the KNKT parameter must be supplied as follows:

KT = 0 Rated range 0 to +27648 (unipolar)

KT = 1 Rated range -27648 to +27648 (bipolar)

2.4.3 Error Handling

In normal processing, the RLO = "0" when the function block is exited, and accumulator 1 contains the value written to the module (xa).

FB 34 sets the BU parameter to "1" when the specified XE input value is outside the range defined by the UGR and OGR parameters. When overrange is set, FB 34 sets the RLO to "1" and outputs the relevant limit value to the module. Accumulator 1 contains the non-linearized value written to the module.

In the event of a parameterization error, the function block sets the RLO to "1". A value is not written to the analog output module, and BU has the signal state "0". An error number is passed in accumulator 1:

- 1 I/O area invalid (BG left byte)
- 2 Channel number invalid (KNKT left byte)
- 3 Channel address exceeds the value 254
- 4 Channel type invalid (KNKT right byte)
- 5 OGR <= UGR

If a non-existent module or channel is selected, there is a timeout. If the CPU then branches to the STOP state, you find the value "00FFh" in accumulator 2 by means of the interrupt stack.

3 Technical Specifications

The standard function blocks use the memory bytes **MB 200** to **MB 255** as a scratchpad flag area.

File	Block No.	Name	Library No. P71200-...	Block Length/ Words	Call Length/ Words	Sub-ordinate Blocks	Nesting Depth
ANA_S7ST.S5D	FB 34	AN-EIN-F	S0034-C-0	426	9	FB 1- FB 4	1
	FB 35	AN-AUS-F	S0035-C-1	262	8	FB 1- FB 4	1
ANAGS7ST.S5D	FB 34	AN-EIN-F	S0034-D-0	310	9	-	0
	FB 35	AN-AUS-F	S0035-D-0	167	8	-	0
	FB 36	AN-EIN-G	S0036-C-0	302	11	-	0
	FB 37	AN-AUS-G	S0037-C-1	158	10	-	0

4 Version Overview

Version	Date	Change
1.0	20.01.1996	First edition
1.1	10.03.97	Separate fixed-point blocks were developed for floating-point CPUs for runtime optimization
1.2	14.05.97	Correction
1.3	14.07.97	Correction

5 Terminology and Abbreviations

CPU	Central processing unit
FB	Function block
IM	Interface module
OB	Organization block
S5	SIMATIC S5
S7	SIMATIC S7
RLO	Result of logic operation

6 References

- /1/ Manual "S7-300 Programmable Controller, Hardware and Installation" (with Reference Manual "Module Specifications")
- /2/ Manual "ET200M Distributed I/O Station" Edition 1 (with Reference Manual "Module Specifications")